

 **Ramp & Cup Collisions**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Class: \_\_\_\_\_

My level: ☐  Explorer ☐  Investigator ☐  Legend

**Mission:** A bowling alley designer asks: does a heavier ball or a faster ball knock pins harder? Roll balls of different masses down ramps of different heights into a cup and measure how far the cup slides.

**Big question:** How do mass and speed affect kinetic energy?

 **Warm-up: Rank it**

Rank from least to most damage in a crash. Explain.

A bike at 5 mph, a truck at 5 mph, a truck at 30 mph

\_\_\_\_\_

Why do trucks need longer to stop than cars?

\_\_\_\_\_

| Key vocabulary       |                                                                                              |
|----------------------|----------------------------------------------------------------------------------------------|
| Kinetic energy       | The energy of a moving object: $KE = \frac{1}{2} \times \text{mass} \times \text{speed}^2$ . |
| Mass                 | How much matter an object has.                                                               |
| Independent variable | The one thing you change on purpose.                                                         |
| Dependent variable   | The thing you measure (cup distance).                                                        |

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Box 1

**Predict**

PREDICTION If you double the ball's mass (2 kg), the cup will move...

☐ about twice as far   ☐ about four times as far   ☐ the same distance

\_\_\_\_\_

**Mass trials**

Record the cup distance.

| Ball mass | Cup moved (cm) |
|-----------|----------------|
| 1 kg      |                |
| 2 kg      |                |
| 4 kg      |                |

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Box 2

**Mass pattern**

You predicted: \_\_\_\_\_. What happens to KE when mass doubles?

☐ KE doubles   ☐ KE stays the same   ☐ KE is cut in half

### 3 Box 3

#### Height trials

Record the cup distance.

| Ramp height | Speed (m/s) | Cup moved (cm) |
|-------------|-------------|----------------|
| 0.5 m       |             |                |
| 2 m         |             |                |

### 4 Box 4

#### Speed matters

Which change gave the ball more kinetic energy?

- ☐ Both doubling the mass and a higher ramp increased KE; a 4× higher ramp gave 4× the KE with only 2× the speed
- ☐ Only mass matters   ☐ Only height matters

### 5 Box 5

#### Legend: calculate KE Legend only

$KE = \frac{1}{2} \times m \times v^2$ . What is the KE of a 2 kg ball moving 3 m/s?

Answer: \_\_\_\_\_ J

Show your thinking:

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### 6 Box 6

#### Advice for the bowling alley (CER)

How do mass and speed affect kinetic energy?

**Claim** Start: "Kinetic energy increases when..."

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**Evidence** Start: "When the mass doubled, the cup..."

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**Reasoning** Start: "The cup moved farther because..."

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#### Exit ticket: answer the big question in your own words

How do mass and speed affect kinetic energy?

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Completion code:

Shown on the last screen of the simulator.